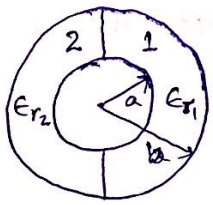
Electrostatics
Center for Engineering Studies

DPP-7 Method of Image

Q-1. The region between two concentric conducting spherical shells is filled with two different dielectrics as shown in fig.



$\epsilon_{r_2} = 4$
$\epsilon_{r_1} = 2$
$a = 2\,mm$
$b = 4\,mm$

Total charge on inner sphere is $4\,\mu C$
Find electric field in medium-1

Q-2. for the above question V_{ab} = ____ volt.

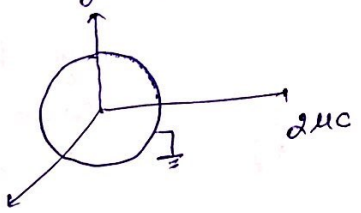
Q-3. Which of the following statement is true

Statement-1 when a point charge is enclosed between two parallel conducting planes, the number of images will be infinite

Statement-2. for two bisecting planes the number of images will be finite as long as the angle between the planes is a submultiple of 360°

(a) Statement-1 (b) Statement-2 (c) both statements are true (d) both statements are false

Q-4. A point charge $2\,\mu C$ is placed at a distance 5 m. from the center of a grounded conducting sphere of radius 2 m.

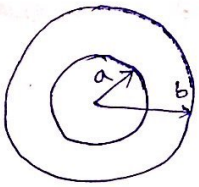


Surface charge density on the sphere will be ____

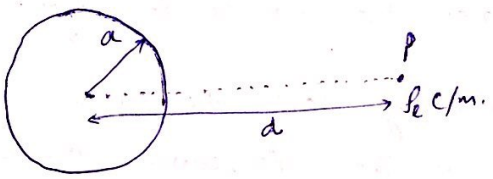
Q-5. A dielectric rod of radius 10 mm extends along z-axis from z=0 to z= 10 m. The polarization of the rod is given as $\vec{P} = (2z^2+10)\,\hat{z}$. Calculate the bound volume charge density ____

Q-6. A metal sphere of radius b = 2 mm has a uniform surface charge distribution. The permittivity of the surrounding region varies as $\epsilon = \epsilon_0(1 + a/r)$. Find potential in the dielectric region at r = 4 mm and value of charge on the sphere is $4\,\mu C$. a = 4 mm.

Q-7. A material with conductivity $\sigma = m/\rho + K$ where m and K are constants, fills the space between two concentric, cylindrical conductors of radii a & b as shown in fig. If V_0 is the potential difference between two conductors, and L is the length of each conductor obtain expression for the resistance of the material, the current density and the electric field intensity in the material.

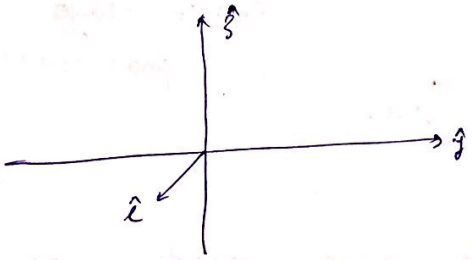


Q-8. An infinitely long conducting cylinder and a infinitely long line charge is shown below.



Find the location of image line charge from the centre of cylinder given that $d = 5m$ $a = 2m$.

Q-9. Region $z<0$ consist of perfect conductor while region $z>0$ is a dielectric medium $\epsilon_r = 2$ as shown in fig. If there is a surface charge of 5 nc/m^2 on the conductor. Determine $|D|$ at $(4, 1, 5)$



Q-10. Two conducting spherical shells have radii $a = 3$ cm & $b = 6$ cm. The interior is a perfect dielectric for which $\epsilon_r = 8$. A portion of dielectric is removed so that $\epsilon_r = 1$ for $0 < \phi < \pi/2$ and $\epsilon_r = 8$ for $\pi/2 \leq \phi \leq 2\pi$. Find the ratio of capacitor C_1/C_2 where C_1 is the capacitor with $\epsilon_r = 8$ in complete interior filled with dielectric and C_2 is capacitor in 2nd case.